IPmux-11

TDM Pseudowire Access Gateway

TDMoIP Driven®

FEATURES

- TDM pseudowire CPE/CLE, offering TDM circuit emulation over a packet-switched network (PSN) and controlled Ethernet access
- Built on TDMoIP technology, implementing the emerging IETF, MFA Forum, ITU-T and MEF standards for Pseudo-Wire Emulation Edge-to-Edge (PWE3)
- E1/T1 emulation over MPLS, IP and Ethernet networks
- Support for both framed (full or fractional) and unframed E1/T1
- Configurable jitter buffer to compensate for network packet delay variation
- Dedicated external clock port
- Ensures TDMoIP priority by QoS marking: ToS, VLAN priority or EXP bits
- Operates opposite other members of RAD's TDMoIP family of products (IPmux-1E, IPmux-14, IPmux-8/16, Gmux-2000, Megaplex ML-IP)
- One Ethernet network port; two Ethernet user ports, offering
  - Transparent Ethernet bridging
  - User data bandwidth and access control through rate limiting and VLAN filtering
  - VLAN tagging and double tagging
- Typical applications:
  - E1/T1 (voice or data) leased line replacement
  - PBX PSTN access
  - Multiservice TDM/Ethernet CLE/CPE
- Management via ASCII terminal, Telnet host, Web terminal or SNMP-based network management station
- Provisioning and monitoring of TDMoIP services using the RADview Service Center for TDMoIP applications
- Compact, 1U high enclosure

DESCRIPTION

- IPmux-11 is a TDM pseudowire access gateway extending TDM-based services over packet switched networks. It also serves as an Ethernet-based access device.

TDMoIP PERFORMANCE

- IPmux-11 provides a legacy over PSN solution transmitting E1/T1 streams over packet switched networks. The device converts the data stream from its user E1/T1 port into packets for transmission over the network. The addressing scheme of these packets is IP or MPLS. These packets are transmitted via the IPmux-11 Ethernet network port to the PSN. A remote TDMoIP device converts the packets back to TDM traffic.
- High-performance buffering and forwarding techniques are used to achieve end-to-end processing delay as low as 3 msec.
- Configurable packet size allows to achieve proper balance between PSN throughput and delay.
- A jitter buffer compensates for packet delay variation (jitter) of up to 300 msec in the network.
- Assigned, IANA-registered UDP port number for TDMoIP simplifies flow classification through switches and routers.

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TDMoIP QoS

- IPmux-11 supports VLAN tagging and priority labeling according to 802.1p&Q. TDMoIP packets are assigned a dedicated VLAN ID and 802.1p bit.
- The ToS or Diffserv of the outgoing TDMoIP packets are user-configurable. This allows the TDMoIP packets to be given a higher priority in IP networks.
- EXP bits are used for QoS marking of the TDMoMPLS traffic in MPLS networks.

TDMoIP TIMING

- Synchronization between TDM devices is maintained, by deploying advanced clock distribution mechanisms. The clocking options are:
  - **Internal** – the master clock source for the TDM circuit is provided by IPmux-11's internal clock oscillator
  - **Loopback** – the transmit clock is derived from the E1/T1 port's receive clock
  - **Adaptive** – the clock is recovered from the PSN
  - **External** – an external clock source to synchronize the device via its station clock port.
- System clock ensures clock resilience by using master and fallback timing sources for clock redundancy. IPmux-11 also provides system clock output via external clock connector.

TDM INTERFACE

- One standard E1 or T1 port provides connectivity to any standard E1 or T1 device.
- E1 and T1 interfaces support the following:
  - Integral LTU/CSU for long haul applications
  - G.703 unframed and G.704 framed modes
  - CAS and CRC-4 bit generation (E1)
  - D4/SF and ESF framing (T1)
  - Robbed bit (T1).

ETHERNET INTERFACE

- IPmux-11 provides the following Ethernet ports:
  - One network port (UTP or fiber optic)
  - Two user ports (both UTP or UTP and fiber optic).
- Each Ethernet port supports:
  - Port-based rate limiting for bandwidth control
  - Port-based VLAN membership for ingress traffic restriction
  - Port-based VLAN tagging
  - Double VLAN tagging (VLAN stacking)
  - Bridging and filtering.

ETHERNET CAPABILITIES

- IPmux-11's internal Layer-2 Ethernet switch provides three Ethernet ports. One port serves as a network interface and the other two serve for user Ethernet traffic.
- Each Ethernet port supports:
  - Configurable port-based rate limiting for bandwidth control
  - Configurable port-based VLAN membership for ingress traffic restriction
  - Configurable port-based VLAN tagging; a VLAN tag is added resulting in a double tagging (VLAN stacking) when an already tagged frame is switched.
- The device supports standard IP features, such as ICMP (ping), ARP, next hop and default gateway.

APPLICATIONS

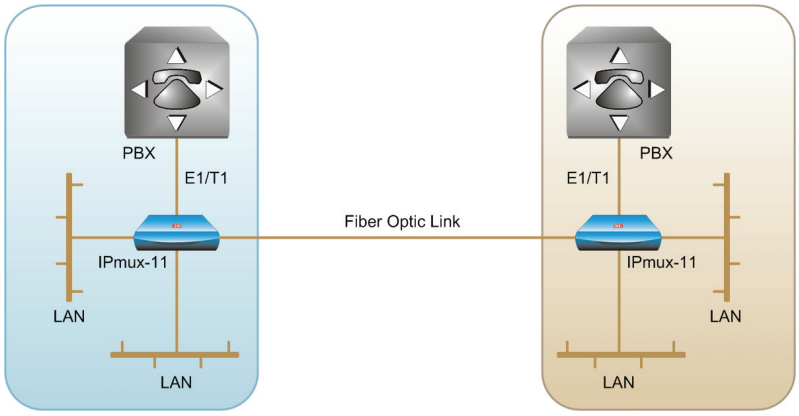

Figure 1. LAN and TDM Services over a Fiber Optic Ethernet Link

DIAGNOSTICS

- External and internal loopbacks can be used to check TDM link connectivity.
- The following E1/T1 physical layer performance statistics are available: LOS, LOF, LCV, RAI, AIS, FEBE, BES, DM, ES, SES, UAS and LOMF.
- IPmux-11 performs an internal built-in test (BIT) after power up. The results of the test are visible via the local terminal.
- LAN and IP layer network condition statistics, such as packet loss and packet delay variation (jitter) are monitored and stored by the device.
- Fault isolation, statistics and event logging are available.
- To enhance fault condition reporting capabilities, remote IPmux-11 transfers RDI, LOS and AIS conditions received from the remote E1/T1 device to the local E1/T1 device via the PSN.

MANAGEMENT

- IPmux-11 can be configured and monitored locally via an ASCII terminal, or remotely via Telnet, Web browser or RADview.
- Management traffic can run over a dedicated VLAN.
- The RADview Service Center and Element Manager packages control and monitor TDM over IP (TDMoIP) devices and circuits. The Service Center's intuitive GUI, "point-and-click" functionality and easy-to-follow wizards increase the efficiency and accuracy of the service provisioning process.
- Software download is supported via the local terminal, using XMODEM, or remotely, using TFTP. After downloading a new software version, IPmux-11 automatically saves the previous version in non-volatile memory for backup purposes. Similarly, copies of the configuration file may be downloaded and uploaded to a remote workstation for backup and restore purposes.

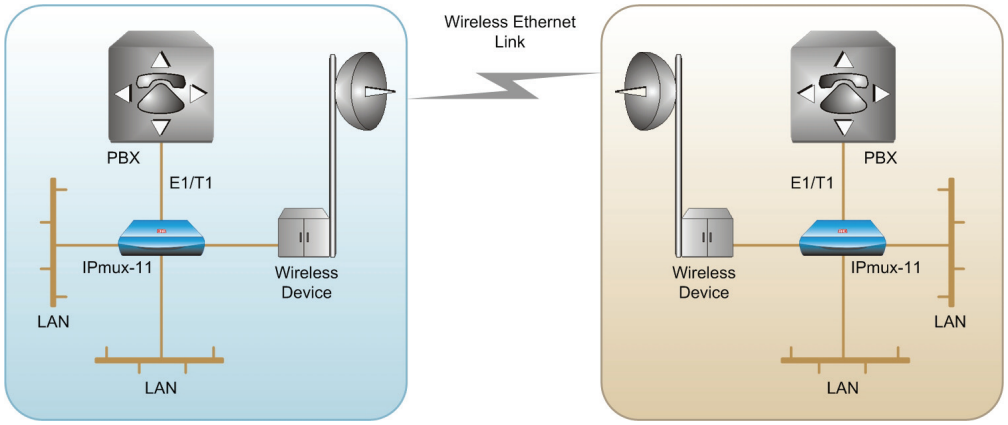

Figure 2. LAN and TDM Services over a Wireless Link

IPmux-11

TDM Pseudowire Access Gateway

SPECIFICATIONS

E1 INTERFACE

- **Number of Ports**
  1
- **Compliance**
  ITU-T Rec. G.703, G.704, G.706, G.732, G.823
- **Data Rate**
  2.048 Mbps
- **Line Code**
  HDB3
- **Framing**
  Unframed, framed, multiframe; with or without CRC-4
- **Signaling**
  CAS, CCS (transparent)
- **Line Impedance**
  - 120Ω, balanced
  - 75Ω, unbalanced
- **Signal Levels**
  Receive: 0 to -36 dB with LTU (long haul)
  0 to -10 dB without LTU (short haul)
  Transmit balanced: ±3V ±10%
  Transmit unbalanced: ±2.37V ±10%
- **Jitter Performance**
  Per ITU-T G.823
- **Connector**
  - Balanced: RJ-45
  - Unbalanced: BNC (RJ-45 to BNC adapter cable is supplied)

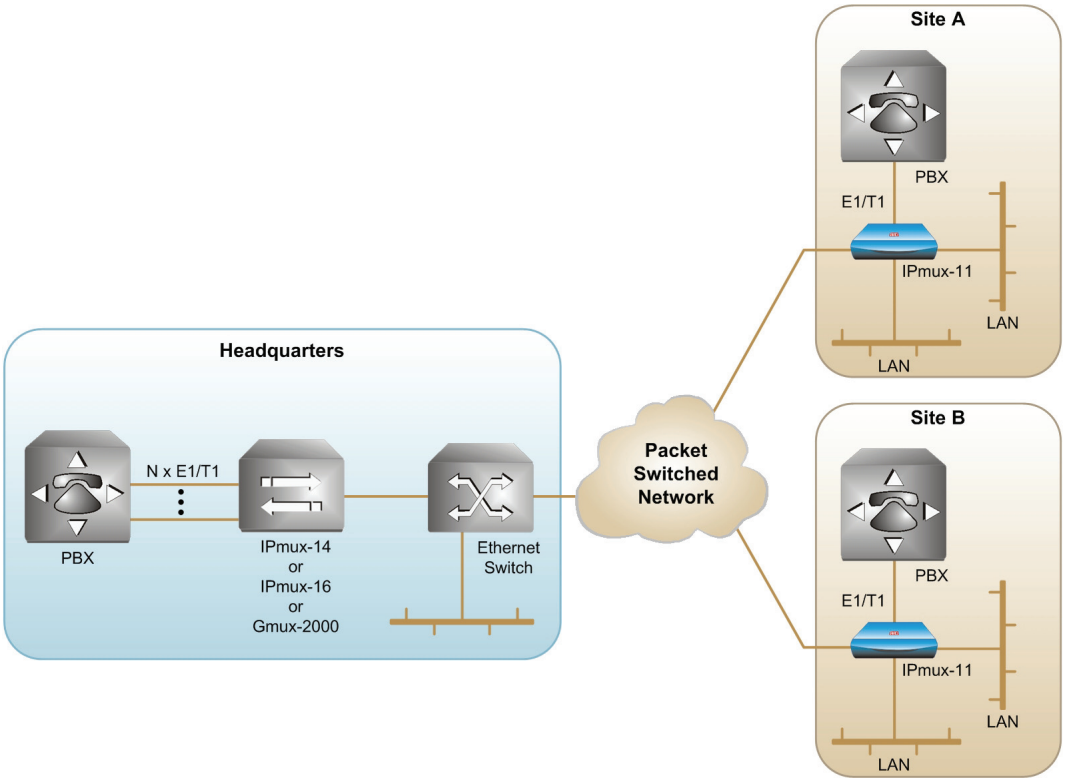

Figure 3. Corporate Multisite Communication over a Packet-Switched Network

T1 INTERFACE

- **Number of Ports**
  1
- **Compliance**
  ANSI T1.403, ITU-T Rec. G.703, G.704, G.824
- **Data Rate**
  1.544 Mbps
- **Line Code**
  B8ZS, B7ZS, AMI
- **Framing**
  Unframed, SF, ESF
- **Signaling**
  CAS (bit robbing), CCS (transparent)
- **Line Impedance**
  100Ω, balanced
- **Signal Levels**
  Receive: 0 to -36 dB
  Transmit pulse amplitude:
  ±3V ±20%; 0 dB, -7.5 dB, -15 dB (CSU), user-selectable
  ±2.7V ±10%, 0 to 655 feet, (DSU), user-selectable
- **Jitter Performance**
  Per AT&T TR-62411, ITU-T G.824
- **Connector**
  RJ-45

ETHERNET INTERFACE

- **Compliance**
  IEEE 802.3, 802.3u, 802.1p&Q
- **Number of Ports**
  - Network: 1 (copper or fiber)
  - User: up to 2 (copper only)
- **Data Rate**
  - UTP: 10 Mbps or 100 Mbps, full or half duplex
  - Fiber: 100 Mbps full duplex
- **Typical Range**
  - 1310 nm LED: 2 km (1.2 mi)
  - 1310 nm laser: 15 km (9.3 mi)
- **Connector**
  LC, SFF-based

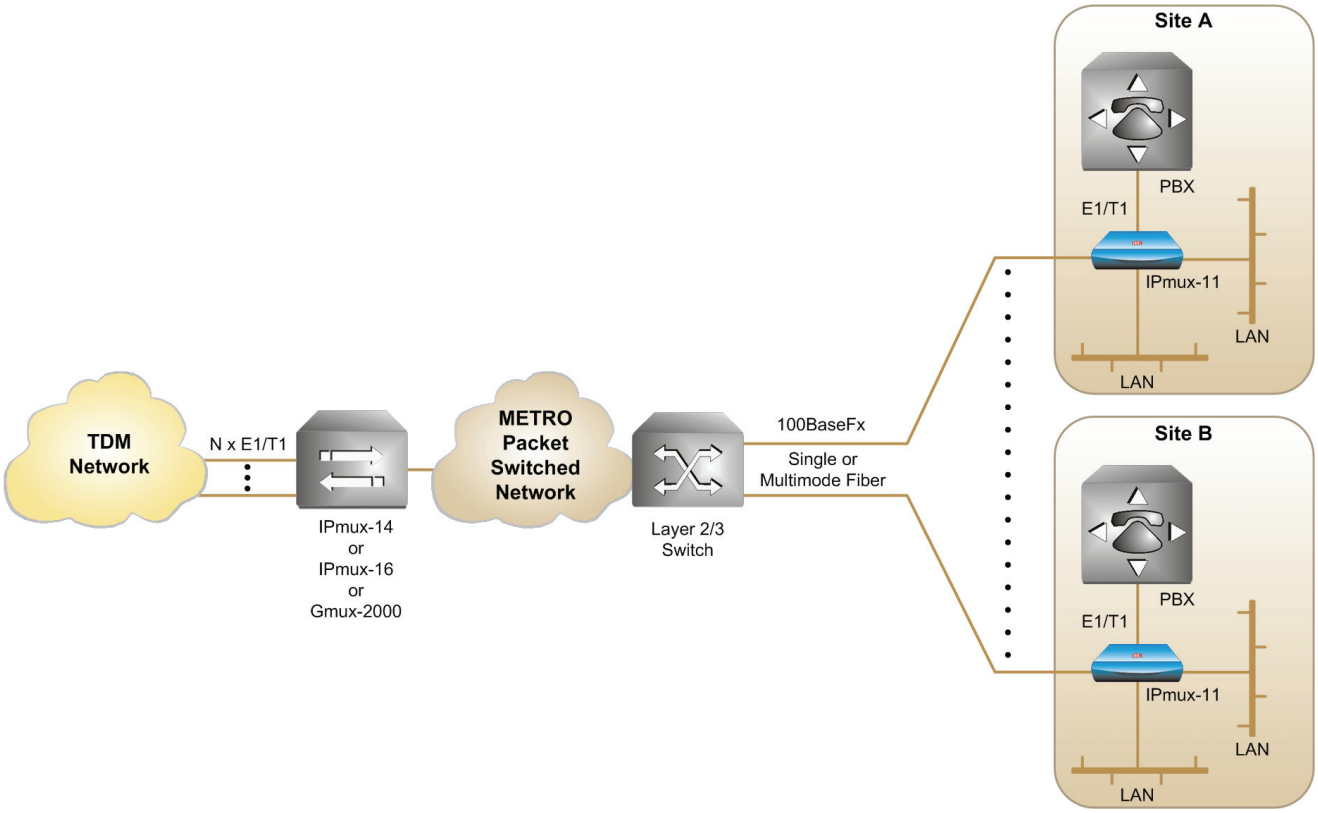

Figure 4. Providing Ethernet in the First Mile

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PSEUDOWIRE CONNECTIONS

- **Number of PW Connections**
  1
- **Jitter Buffer Size**
  3–300 msec with 1 msec granularity

GENERAL

- **Timing**
  - Internal
  - External input or output via dedicated connector: E1/T1 or 2048/1544 kHz squarewave (RS-485 electrical levels)
  - Loopback
  - Adaptive
- **Management**
  - SNMPv1
  - Telnet
  - RADview Service Center TDMoIP (ordered separately)
  - ASCII terminal via V.24 (RS-232) DCE port
- **Diagnostics**
  - E1/T1 local loopback
  - E1/T1 remote loopback
  - Facility Type 1 (FAC1) inband loopback
  - CSU loopback as per Telecordia GR-54
- **Statistics**
  - E1/T1 (per G.826 and RFC 2495)
  - Ethernet (per RFC 2819)
  - Jitter buffer indication (overflow, underflow, sequence error)
- **Indicators**
  PWR (green) – Power status
  ALM (red) – Alarm status
  E1/T1 SYNC (green/red) – E1/T1 synchronization status
  LINK/ACT (green) – Ethernet link/activity status
  EXT CLK (green/red) – External clock status
- **Power**
  AC/DC: 100–240 VAC or -40/-60 VDC
- **Power Consumption**
  8W max
- **Physical**
  Height: 43.7 mm (1.7 in)
  Width: 240 mm (9.4 in)
  Depth: 170 mm (6.7 in)
  Weight: 0.5 kg (1.1 lb)
- **Environment**
  Temperature: 0–50°C (32–122°F)
  Humidity: Up to 90%, non-condensing

ORDERING

IPmux-11/+/&/%
TDM pseudowire access gateway

\+ Specify TDM interface type:
E1 for balanced E1 interface
E1CX for unbalanced E1 interface
T1 for T1 interface

***Note**: Unbalanced E1 interface is provided via RJ-45 to BNC adapter cables supplied with the product.*

& Specify network Ethernet interface type:
UTP for 10/100BaseT interface, RJ-45 connector
MM13LC for multimode 1310 nm 100BaseFx interface, LC connector
SM13LC for single mode 1310 nm 100BaseFx interface, LC connector

% Specify **UTP** for 10/100BaseT user interface, RJ-45 connector

SUPPLIED ACCESSORIES

Power cord

AC/DC adapter plug

CBL-RJ45/2BNC/E1/X
RJ-45 to BNC adapter cable (if an unbalanced E1 interface has been ordered)

OPTIONAL ACCESSORIES

RM-33-2
Hardware kit for mounting one or two IPmux-11 units into a 19-inch rack

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